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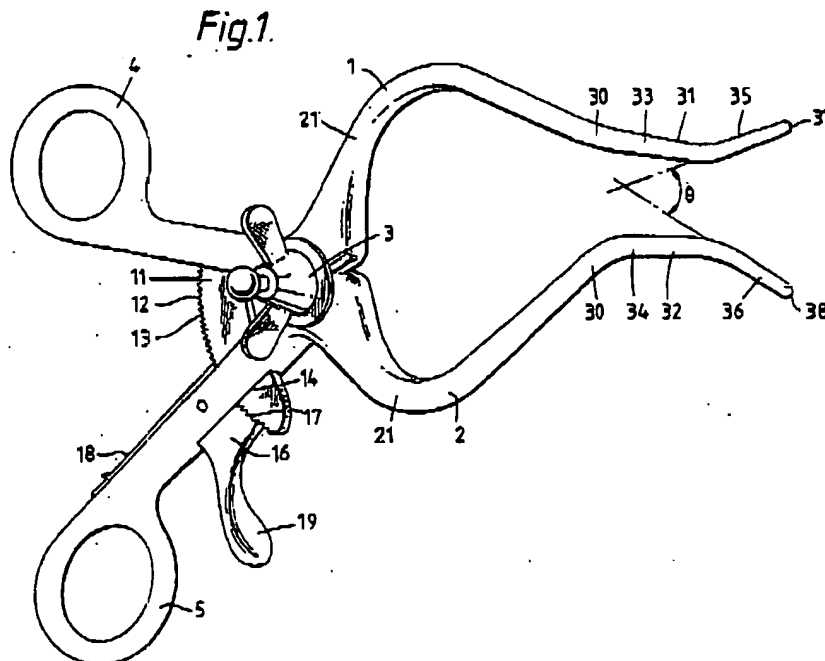
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Selected US specifications from IPC sub-class

A61B

(54) Distractor

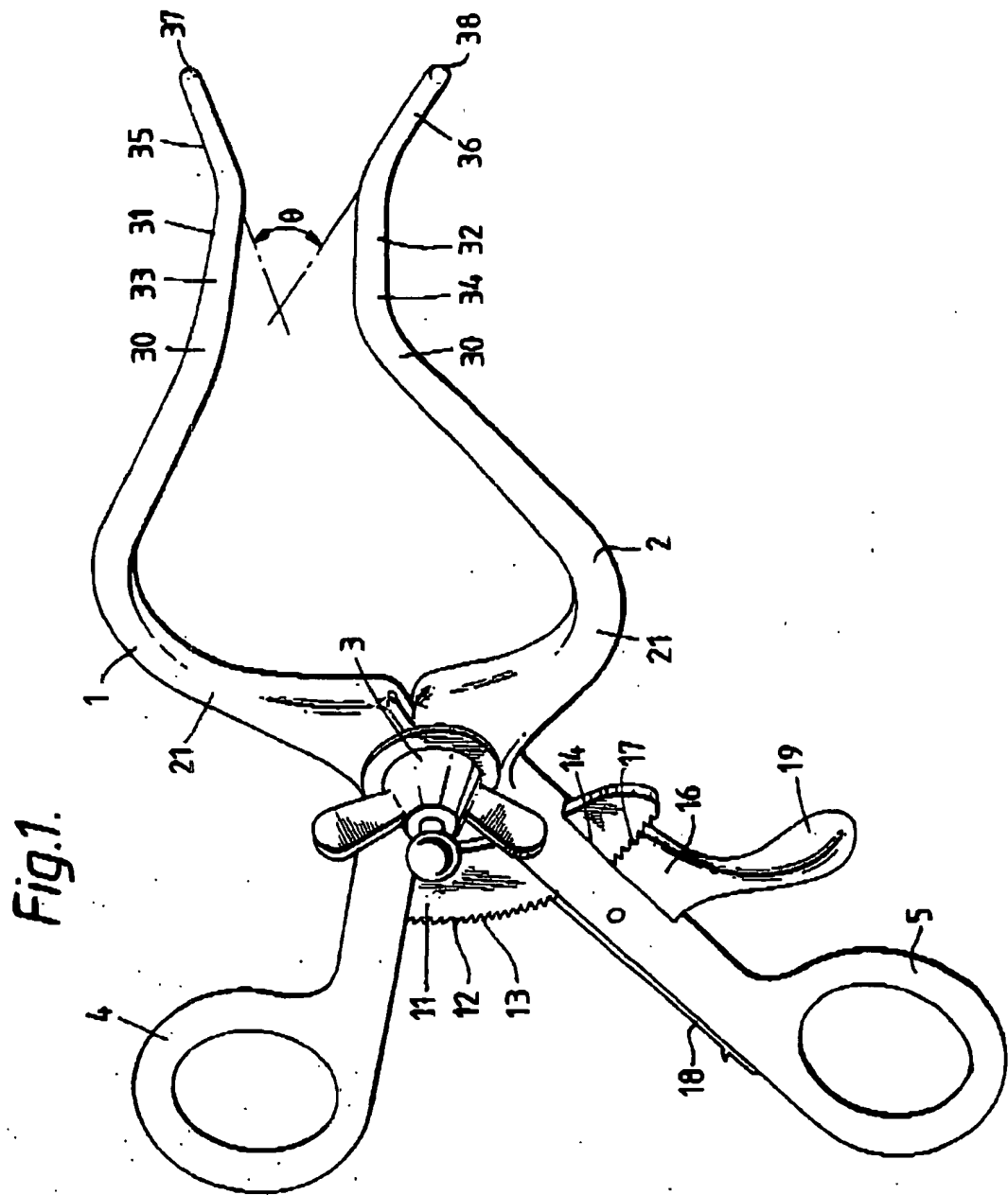
(57) Joint (e.g. temporomandibular) distractor comprising a pair of arms (1,2) hinged together (3) and means (e.g. ratchet mechanism 11-19) for locking the arms in a fixed position. The distal arm ends (35, 36) are inclined away from each other ( $\theta$  is typically  $60^\circ$ ) and the instrument phone and the tips (37, 38) are suitable (e.g. circular) for insertion in drilled holes or recesses in the relevant bones.



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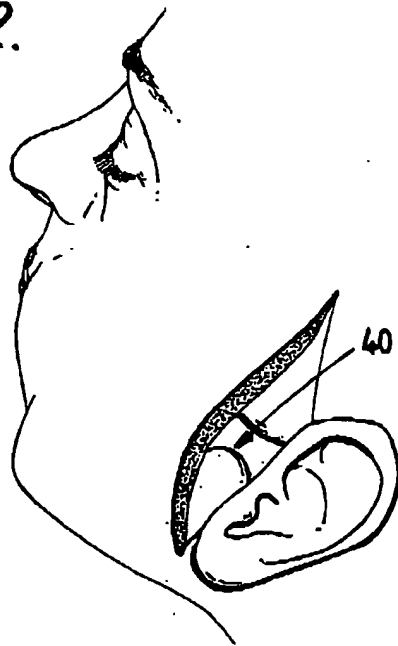
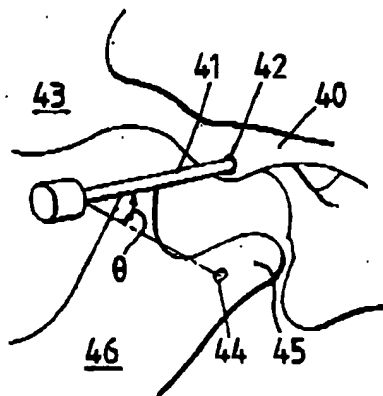
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*Fig.2.**Fig.3.*

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Fig. 4.

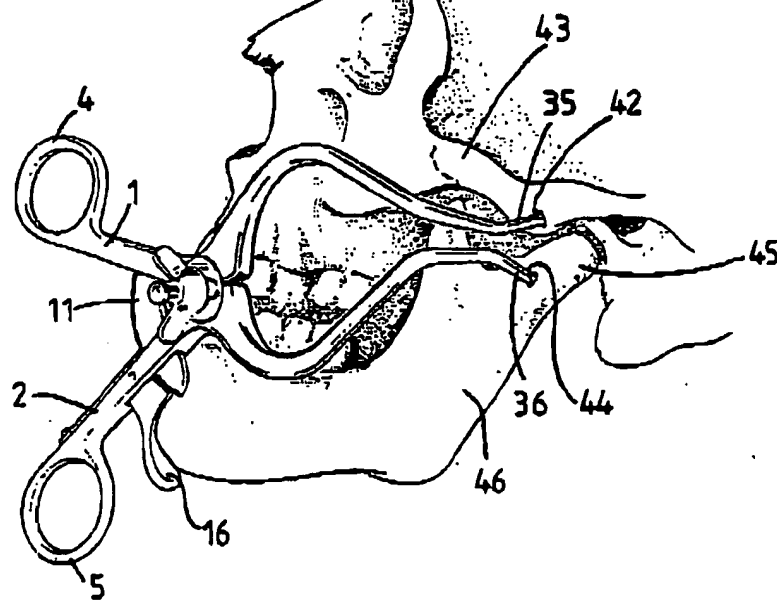
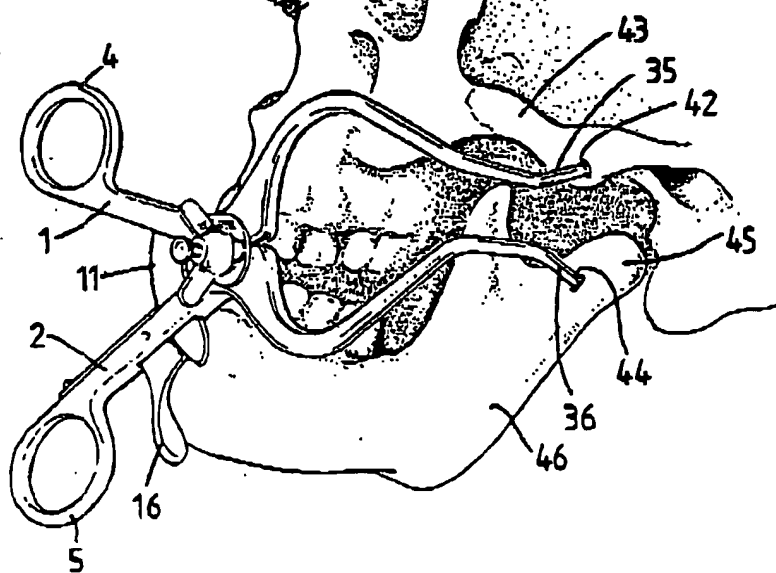


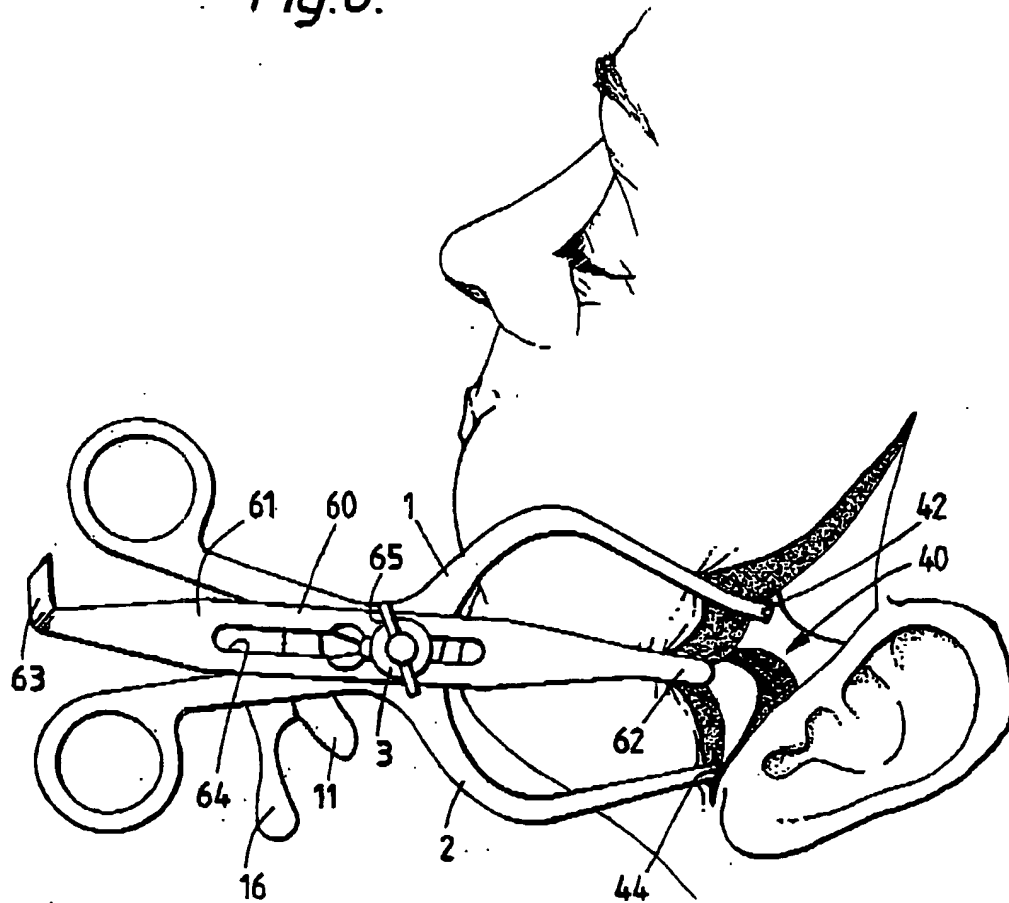
Fig. 5.



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Fig.6.



SURGICAL INSTRUMENTS

This invention relates to surgical instruments.

The invention is more particularly concerned with instruments for use in separating the temporomandibular joint such as to enable surgical reconstruction of the joint.

Numerous operations have been devised to treat temporomandibular joint dysfunction. The approach to the joint is generally through a preauricular incision which gives good access and avoids the upper branches of the facial nerve. Until recent years, most of these operations have been of a destructive nature, where access to the joint compartment has to be transitory and the surgery relatively crude. With the advent of the various operations devised to reconstruct the soft tissues of the joint, improved access has become paramount.

During such operations, the joint surfaces have to be distracted and held sufficiently wide apart and stable to reconstruct the meniscus. There has to be adequate space to enable the operator to introduce sutures across the posterior band and bilaminar zone from the medial to the lateral side. It is insufficient simply for the assistant to grasp the mandible by various means and manipulate the condyle. If instrumentation is introduced into the joint space this impedes the surgeon and damages the joint surfaces. Inserting K-wires into the eminence and neck of the condyle and securing a clamp upon them has merit, but is bulky and again restricts the space in which to manipulate instruments.

It is an object of the present invention to provide a surgical instrument which can be used to alleviate these disadvantages.

According to the present invention there is provided a surgical instrument for use in distraction of the temporomandibular joint, the instrument comprising a pair of arms hinged with one another such that the angle between the arms in the plane of the instrument can be varied to alter the separation between the patient end of the arms, and means for locking the arms together to hold the patient ends of the arms in a desired separation, the patient end of the two arms being inclined away from the plane of the instrument and away from each other, and the patient end of each arm being shaped to be received respectively in a drilled recess formed in the mandible and the temporal bone.

The arms are preferably hinged with one another at a location intermediate their ends, the end of each arm remote from the patient end being provided with manual gripping means. The manual gripping means may be in the form of a ring on each arm for receiving the finger and thumb of the user. The locking means preferably comprises a ratchet plate mounted with one arm and a releasable locking pawl mounted with the other arm. The arms may be bowed outwardly on the patient side of the point where the arms are hinged together, a portion of the arms towards the patient end of the instrument are inclined substantially at right angles to the plane of the instrument. The patient end of the two arms are preferably inclined outwardly away from each other at an angle of substantially 60 degrees and taper in thickness along their length from the point where they are hinged together to their patient end where they are of smaller thickness and of substantially circular section. The strength of the arms is preferably



such as to allow them to flex when forces above 2.5kg are applied at their patient end.

The instrument may include a soft tissue retractor for holding tissue away from the region of the temporomandibular joint. The soft tissue retractor is preferably mounted on the instrument at the point where the two arms are hinged together, the length of the retractor between its patient end and the hinge point of the arms being selectively adjustable.

An instrument according to the present invention for use in distraction of the temporomandibular joint will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of the instrument;

Figures 2 to 5 show the method in which the instrument is used; and

Figure 6 shows a modified version of the instrument.

With reference first to Figure 1, the instrument has two arms 1 and 2 of a metal such as stainless steel, tungsten or titanium that are hinged with each other at a joint 3 substantially midway along their lengths. The handle part of each arm 1 and 2 extending rearwardly from the hinged joint 3 is straight and is terminated with a ring 4 and 5 shaped to receive a finger and thumb of the surgeon.

The rear part of the upper arm 1 carries a ratchet in the form of an arcuate plate 11 that extends in the plane of the instrument towards the rear part of the opposite arm 2. The rear curved edge 12 of the ratchet plate 11 is cut with inclined teeth 13. The ratchet plate 11 projects through an opening 14 in the rear part of the lower arm 2. In the rear end of the opening 14 there is journaled a pawl lever 16 which has a toothed surface 17 that is urged into contact with the toothed edge 12 of the ratchet plate 11 by means of a leaf spring 18. The pawl lever projects outwardly of the arm 2 and, at its outer end, is formed with a finger engaging tab 19. By pulling the tab 19 rearwardly, the pawl lever 16 can be displaced in a clockwise sense thereby bring its toothed surface 17 out of engagement with the ratchet plate 11.

The forward end of each arm 1 and 2 is bowed outwardly in a region 21 immediately forward of the hinged joint 3, both arms extending generally in the plane of the instrument over this bowed region. At a location 30 about two thirds of the distance along the forward portion of the arms 1 and 2 they are bent approximately at right angles to the plane of the instrument to form projecting fingers 31 and 32 respectively. Each finger is divided into two parts: a straight rear portion 33 and 34 which extend generally parallel to each other, and a patient end tip 35 and 36 which are each

straight and are inclined outwardly from one another at an angle  $\theta$  of sixty degrees. The arms 1 and 2 taper in thickness along their length from the hinged joint 3 to the tips 35 and 36 which are both of smaller thickness and of circular section with rounded ends 37 and 38.

In the closed state of the instrument, the rear portions 33 and 34 of the fingers 31 and 32 lie against one another with the tips 35 and 36 inclined outwardly at an angle of sixty degrees. In this state, the rings 4 and 5 at the rear of the instrument will be at their maximum separation. The inclination of the teeth 13 on the ratchet plate 11 and of those on the toothed surface 17 of the pawl lever 16 are such that they slide over one another when the rear end of the arms 1 and 2 are closed and the forward end is opened. If, however, force is applied to close the forward end of the arms, the teeth on the ratchet plate 11 and pawl lever 16 engage and resist any such displacement. The forward end of the instrument can only be closed by pulling the tab 19 to release the pawl lever 16.

Use of the instrument in a method of holding the temporomandibular joint separated will now be described with reference to Figures 2 to 5.

A preauricular incision is first made, as shown in Figure 2, to expose the temporomandibular joint 40.

Using a Number 8 round burr 41 a hole or recess 42 is drilled in the eminentia articularis of the joint 40, in the temporal bone 43, as shown in Figure 3. A hole 44 of the same size is also drilled in the neck of condyle 45 of the mandible 46. The holes 42 and 44 are drilled at an

angle  $\theta$  of sixty degrees to each other so that they align with the tips of the instrument.

With the instrument in a closed, or almost closed state, its tips 35 and 36 are inserted into the drilled holes 42 and 44 respectively, as shown in Figure 4.

The handle, rear end of the instrument is then gripped and the two arms 1 and 2 squeezed together to open the forward end of the instrument and hence distract the temporomandibular joint 40, as shown in Figure 5. When the required separation between the mandible 46 and temporal bone 43 is achieved, the handle of the instrument can be released, the instrument being held in the open position by the pawl lever 16 and ratchet 11. Because the two tips 35 and 36 of the instrument and the two holes 42 and 44 are inclined with respect to each other, the instrument is retained securely in the drilled holes without the need for any additional securement.

The joint surfaces can be distracted up to a maximum separation of about 12mm which is sufficient to inspect the joint surfaces and contents and to manipulate surgical instruments needed to treat the joint surfaces and meniscus.

The dimensions and material of the arms 1 and 2 are preferably selected so that the strength of the arms allows them to flex when forces above about 2.5 kg are applied at the tip, so as to avoid applying undue force on the soft tissues which remain holding the joint surfaces in apposition.

The instrument can also be used to control the position of the condyle 45 in the sagittal plane by rotating the handles of the instrument in a cranial direction about a pivot point provided by the tip 35 in the hole 42 in the temporal bone. This can be used to bring the condyle 45 forward sufficiently to enable inspection of the posterior aspect of the condyle and the insertion of sutures into the lower part of the bilaminar zone, if desired.

The instrument can be modified, as shown in Figure 6 to include a soft tissue retractor 60. The retractor 60 is formed by an elongate plate 61 that is bent at its forward end in the same general direction as the tips 35 and 36 of the arms 1 and 2, to form a hook 62. The rear end of the plate 61 is bent in the opposite sense to form a handle 63. The plate 61 has an axial slot 64 running along its central portion by which the retractor 60 is mounted on the hinged joint 3. A wing nut 65 mounted on the joint 3 is used to lock the retractor in the desired position.

In use, the tips of the instrument are inserted in the drilled holes in the bones, the retractor 61 is pushed forwardly so that the hook 62 catches on the soft tissue. The retractor 61 is then pulled rearwardly by gripping the handle 63 so that the tissue is pulled away from the region of the joint 40, thereby exposing it. The wing nut 65 is then tightened to hold the retractor in the desired position.

CLAIMS

1. A surgical instrument for use in distraction of the temporomandibular joint, wherein the instrument comprises a pair of arms hinged with one another such that the angle between the arms in the plane of the instrument can be varied to alter the separation between the patient end of the arms, and means for locking the arms together to hold the patient ends of the arms in a desired separation, wherein the patient end of the two arms are inclined away from the plane of the instrument and away from each other, and wherein the patient end of each arm is shaped to be received respectively in a drilled recess formed in the mandible and the temporal bone.
2. A surgical instrument according to Claim 1, wherein the arms are hinged with one another at a location intermediate their ends, and wherein the end of each arm remote from the patient end is provided with manual gripping means.
3. A surgical instrument according to Claim 2, wherein the said manual gripping means is in the form of a ring on each arm for receiving the finger and thumb of the user.
4. A surgical instrument according to any one of the preceding claims, wherein the said locking means comprises a ratchet plate mounted with one arm and a releasable locking pawl mounted with the other arm.

5. A surgical instrument according to any one of the preceding claims, wherein the said arms are bowed outwardly on the patient side of the point where the arms are hinged together.
6. A surgical instrument according to any one of the preceding claims, wherein a portion of the arms towards the patient end of the instrument are inclined substantially at right angles to the plane of the instrument.
7. A surgical instrument according to any one of the preceding claims, wherein the patient end of the two arms are inclined outwardly away from each other at an angle of substantially 60 degrees.
8. A surgical instrument according to any one of the preceding claims, wherein the arms taper in thickness along their length from the point where they are hinged together to their patient end where they are of smaller thickness and of substantially circular section.
9. A surgical instrument according to any one of the preceding claims, wherein the strength of the arms is such as to allow them to flex when forces above 2.5kg are applied at their patient end.
10. A surgical instrument according to any one of the preceding claims, including a soft tissue retractor for holding tissue away from the region of the temporomandibular joint.

11. A surgical instrument according to Claim 10, wherein the soft tissue retractor is mounted on the instrument at the point where the two arms are hinged together, and wherein the length of the retractor between its patient end and the hinge point of the arms is selectively adjustable.
12. A surgical instrument substantially as hereinbefore described with reference to Figures 1 to 5 of the accompanying drawings.
13. A surgical instrument substantially as hereinbefore described with reference to Figures 1 to 5 as modified by Figure 6 of the accompanying drawings.
14. Any novel feature or combination of features as hereinbefore described.